(24)

Plant Development 24th Workshop

Royal Ontario Museum, Saturday, 31 March 1990

0800-0900 Registration and poster set-up, McLaughlin Planetarium Multi-room

0900 Opening Remarks, Planetarium Lecture Room
0915 Pamela DIGGLE. **Development and evolution in plants: issues and approaches.**
0945 Bernard JEUNE. **Quantitative aspects of leaf development.**
1000 Carol RITLAND & Neil A. STRAUS. **Hybridization of yellow monkeyflower.**
1015 BREAK
1030 Sonia SAVARD & K. Peter PAULS. **Protein synthesis during somatic embryogenesis in alfalfa.**
1045 Susan A. KAMULA & Carol A. PETERSON. **Development of suberin lamellae in the exodermis of onion roots subjected to various levels of desiccation.**
1100 Tim DICKINSON, Svenja BELAOUSSOFF & Rhoda LOVE. **Occurrence and frequency of gametophytic apomixis in *Crataegus douglasii* Lindl. (Rosaceae: Maloideae).**

1115-1230 Poster viewing (lunch available in the ROM cafeteria)

1230-1330 Planetarium show: **Voyages to the Planets** (optional; free with registration)

1330-1400 Poster viewing (and dismantling)

1400 Alicja ZOBEL. **Mother cells for nodes and internodes originate directly under the tunica in some plants.**
1415 Mitchell CRUZAN. **Pollen-style interactions in tristylous *Eichhornia paniculata*.**
1430 Josef Daniel ACKERMAN. **Sex in fluids: pollen convergence in marine monocots.**
1445 Christian LACROIX. **Developmental morphology of *Leea guineensis*.**

1500 Invited Speaker: Keith Stuart THOMSON. **Development, systematics, and the evolution of major morphological novelties.**

1600 Discussion, followed by reception in the ROM Staff Lounge.

Sex and fluids: pollen convergence in marine monocots. **JOSEF DANIEL ACKERMAN. Section of Plant Biology, Cornell University, Ithaca NY and 45 Owen Blvd., Willowdale ON M2P 1G2.**

Filiform pollen morphologies are convergent and unique to the marine monocots or "seagrasses". Developmental studies provide insight into the ontogeny and phylogeny of this character, while biophysical studies provide insights into its evolution. In the Hydrocharitales, spherical and elliptical pollen grains become functionally-filiform through early pollen tube germination, tandem transport in mucilaginous chains and linear tetrad formation. In the Potamogetonales, differences in pollen development, pollen wall structure and pollen arrangement in anthers, reveal that filiform pollen have evolved more than once. Clearly there have been strong selection for this peculiar shape. Recent work indicates that there are fluid dynamic advantages for filiform shapes that do not apply to spherical ones. Filiform and functionally filiform pollen morphologies are, therefore, considered adaptations to submarine pollination.

In vitro embryo formation and regeneration of cereal microspores

U.H. Cho, A. Ziauddin, R. Petroski, E. Simion and K.J. Kasha
Department of Crop Science, University of Guelph
Guelph, Ontario N1G 2W1

Induction of embryo formation and plantlet formation from in vitro cultured microspores of barley (Hordeum vulgare) and wheat (Triticum aestivum) is being investigated. Many factors are involved in inducing embryo or callus formation and eventually plant regeneration from anthers or microspores. Growth condition of donor plants, pretreatment, medium composition and culture condition are all of importance. A cold pretreatment of spikes (at 4°C for 28 days) is required in some genotypes while in others it can be substituted by a 3-4 day preculture of anthers in 0.3 M mannitol solution. Carbon source (e.g. sucrose, maltose), nitrogen source and concentration, and plant growth regulator (auxin and CK) are some of the critical factors in medium composition. Senescence (ethylene production and membrane degeneration) of anther or microspore has been observed and its role in induction of embryo has been speculated. The role of different factors in the varying response of different genotype will be discussed.

Leaf development in conventional and semi-leafless peas (*Pisum sativum* L.).

RICHARD CÔTÉ AND JEAN M. GERRATH. Department of Horticultural Science, University of Guelph, Guelph, Ont. N1G 2W1.

The comparative development of conventional and semi-leafless pea cultivars was investigated. Leaves of conventional peas consist of stipules, leaflets and tendrils, whereas semi-leafless mutants replace leaflets with tendrils. The general pattern of primordium initiation is the same in both cultivars. However, in the semi-leafless phenotype, second order tendril primordia arise on the oldest first order tendril primordia, resulting in a more complex pattern than a direct homeotic replacement of primordia. Following initiation, pea leaf development can be broadly divided into three stages, based on tendril function. During stage 1, the leaf is still expanding and tendrils show no coiling response. At stage 2, tendrils are capable of thigmotropism, which involves elongation. By stage 3, tendrils have lost the capacity to coil, as well as to elongate. The proportion of material diverted to tendril formation measured by weight or area increases upwards through the canopy. Further data that relate structure and function of the pea tendril will be discussed.

Pollen-style interactions in tristylous *Eichhornia paniculata*.

M. B. CRUZAN. Department of Botany, University of Toronto, Toronto, Ontario M5S 3B2, CANADA.

High levels of disassortative mating and low selfing rates have been reported in several natural and experimental populations of tristylous *E. paniculata*. This is unexpected since plants are fully self- and intramorph compatible, exhibit large floral displays, and capture significant amounts of illegitimate pollen. We investigated the contribution of differential pollen germination, pollen tube growth rate, and pollen-style compatibility (pollen tube attrition), to patterns of non-random mating. Crosses were made among the three floral morphs using pollen from both anther levels of each morph to compare legitimate (pollen from the same anther height as the stigma) with illegitimate (pollen from a different anther height) intermorph crosses, and intramorph with self crosses for the three style morphs. On the stigmas of all style morphs pollen germination rate was fastest for pollen from the short anther level, followed by pollen from the mid and long anther levels, respectively. Overall germination was fastest for pollen placed on stigmas of the long morph, followed by the mid and short morphs, respectively. There were no differences in pollen germination rate between legitimate vs. illegitimate or self vs. outcross pollinations. Pollen tube growth rate differed for the three anther levels, but depended on the length of the recipient style; for all three morphs legitimate pollen grew faster than illegitimate pollen. There was no difference in pollen tube growth rate when illegitimate and self crosses were compared. The results suggest that faster pollen tube growth for legitimate pollen contributes to the observed levels of disassortative mating and high outcrossing rates, but also indicate that disassortative pollen transfer may be important.

Occurrence and frequency of gametophytic apomixis in *Crataegus douglasii* Lindl. (Rosaceae: Maloideae).

T. A. DICKINSON, Department of Botany, Royal Ontario Museum, 100 Queen's Park, Toronto, ON CANADA M5S 2C6, S. BELAOUSSOFF, Biology Department, York University, North York, ON CANADA M3J 1P3, and R. M. LOVE, 393 FulVue Drive, Eugene OR 97405, U. S. A.

Using Nomarski Differential Interference Contrast microscopy we examined the relationship between morphotype and frequency of gametophytic apomixis in *Crataegus douglasii*. Variety *douglasii* has flowers with approximately 10 stamens each, and appears to be polyploid and self-compatible, while var. *suksdorfii* Sarg. has flowers with approximately 20 stamens each, and appears to be diploid and self-incompatible. Although ranges of the two varieties overlap in some places, var. *suksdorfii* is predominantly found west of the Cascades. Variety *douglasii* has a disjunct distribution, on the eastern slopes of the Cascades and in the Rocky Mountains, and in the northern Great Lakes basin. Cleared or sectioned ovules of both varieties contained multiple megagametophytes as well as single ones, but the former were more frequent in var. *douglasii* than in var. *suksdorfii*. These results suggest possible hypotheses concerning the origin of the varieties of *Crataegus douglasii* and their cytological, morphological, and ecological differentiation.

Development and evolution in plants: issues and approaches.

PAMELA DIGGLE. Department of Botany, University of Toronto, Toronto ON M5S 3B2.

Quantitative aspects of leaf development.

B. JEUNE. Université Pierre et Marie Curie - Paris, France.

The classical model for the growth of leaves in terms of marginal meristems emphasizes a single entire leaf as the basic pattern. However, simple leaf does not necessarily mean simple structure. This becomes evident from qualitative and quantitative studies (distribution and orientation of mitoses, growth rates, rhythms of lobing, ...). On the basis of these studies, a description can be given in which the classical model, whether right or not, appears useless in our understanding of the processes involved. In this description, supported by some theoretical and experimental designs, the development of the leaf does not seem to be very different from that of the shoot and reminds us of Arber's partial shoot theory of the leaf.

Development of Suberin Lamellae in the Exodermis of Onion Roots Subjected to Various Levels of Desiccation

SUSAN A. KAMULA and CAROL A. PETERSON
Department of Biology, University of Waterloo
Waterloo, Ontario, N2L 3G1

Onion roots have a dimorphic exodermis in which cells are of two different sizes, i.e. long and short, alternating in an irregular pattern. As the exodermis matures thin, continuous layers of suberin may be laid down over the entire inner wall surface. In some plant species with a dimorphic exodermis, suberin lamellae are absent or delayed in development in the short cells. Because suberin is hydrophobic, one function of suberin lamellae may be to prevent water loss from roots to soil during drought. An experiment was performed to determine whether all cells of the exodermis in onion roots eventually develop suberin lamellae and whether or not water stress accelerates suberization. Suberin lamellae were detected in transverse sections using the lipophilic stain Fat red. Results of this study indicate that regardless of age of root or level of desiccation, there exist exodermal cells still lacking suberin lamellae. Although the number of cells with suberin lamellae increased with increasing age of root, desiccation up to 10 weeks did not induce a significant increase of suberin lamellae development in the onion root exodermis.

Developmental morphology of *Leea guineensis*.

C. R. LACROIX, Department of Biology, McGill University, Montreal, Québec, J. M. GERRATH, Department of Horticultural Sciences, University of Guelph, Guelph, Ontario, and U. POSLUSZNY, Department of Botany, University of Guelph, Guelph, Ontario.

The early ontogeny of the compound leaves and their associated stipules in *Leea guineensis* G. Don was studied using SEM. At initiation, the leaf primordium uses up most of the shoot meristem which fluctuates greatly in size at different stages of development. Continuous meristematic regions at the base of the leaf primordium, later recognized as stipules, grow around, and enclose the apical meristem. The continuity between the leaf, the stipules, and the shoot axis is striking at early stages of development, making it difficult to delimit these different structures. If growth processes such as timing and duration of growth, and meristem fusion or extension, are used to explain the vegetative morphology of *L. guineensis*, visualizing the relationship between the leaf, the stipules, and the shoot axis becomes easier.

The *Brachiaria distachya* complex: polyploidy, hybridization, apomixis, and speciation. **M. MUNIYAMMA[1] AND G. P. BASAPPA[2]. (1) Department of Plant Sciences, University of Western Ontario, London N6A 5B7 and (2) D. R. S. College, Shimoga 577 201, Karnataka, India.**

The *Brachiaria distachya* complex contains morphologically distinct groups at three ploidy levels: tetraploid (2n = 36, prostrate); hexaploid (2n = 54, procumbent); and octaploid (2n = 72, procumbent and glabrous). Pollen meiosis is remarkably regular at each ploidy level, with one significant exception. A fourth group (hexaploid, 2n = 54) exhibits unique reproductive and vegetative features as well as many meiotic irregularities, and is morphologically intermediate between the tetraploid and octaploid groups. Further studies have confirmed the hybrid origin of this group, and that it reproduces by means of facultative aposporous apomixis. Justification is presented for a taxonomic treatment of each of these four groups as separate species, viz. *Brachiaria distachya* (L.) Stapf, *B. miliformis* (Presl) A. Chase, *B. hybrida* Basappa and Muniyamma, and *B. subquadripara* (Trin.) Hitch. It is presumed that the tetraploids represent the progenitors of the entire complex.

RITLAND, CAROL and NEIL A. STRAUS. Department of Botany, University of Toronto, Toronto, Ontario, M5S1A1, Canada.

Hybridization studies of yellow monkeyflowers.

The yellow monkeyflower species complex (Section Similois of *Mimulus*) consists of several taxa whose relationships are complex and uncertain. These taxa are distributed from the Pacific Ocean to the High Sierra in California, and vary in levels of inbreeding. Genetic differences among eight taxa were studied via artificial hybridization and morphometric analyses of parents and hybrids. Taxa studied included the outbreeders *M. guttatus, M. nasutus, M. glaucescens* and *M. Tilingii* and the inbreeders *M. nudatus, M. laciniatus* and *M. platycalyx*. Starch gel electrophoresis confirmed the presence of hybrids. Seeds were counted, weighed and percentage of germination determined. The success of hybridization between taxa largely mirrored their genetic distances found at isozyme loci, except that *M. laciniatus* crossed better with the common monkeyflower group. Hybrids were grown to maturity. Morphological measurements of these hybrids and their parents were used in a discriminant function analysis to further characterize species relationships, and to characterize the genetic basis for morphological differences between these taxa.

Protein Synthesis During Somatic Embryogenesis in Alfalfa

S. Savard and K.P. Pauls
Crop Sci. Dep., University of Guelph, Guelph, Ont. N1G 2W1

Certain genotypes of alfalfa have the capacity to undergo somatic embryogenesis. This trait is genetically determined and can be followed in crosses between embryogenic and non-embryogenic genotypes. The purpose of the study is to examine the patterns of protein synthesis at several tissue culture stages, in embryogenic and non-embryogenic alfalfa genotypes.

Petioles, petiole callus, cell suspension and embryo differentiation cultures were labelled with ^{35}S-methionine. The soluble proteins were extracted and separated by 1D (Native or SDS) and 2D (Native/SDS) polyacrylamide gel electrophoresis. For the embryogenic genotype (C2-4), the pattern of protein synthesis (1D-SDS) was very different in the various tissue culture stages, although some protein bands were present in more than one stage. Some of the polypeptides in the latter stage cultures of the embryogenic genotype (C2-4) were absent from the cultures of the non-embryogenic genotype (Arrow). Protein synthesis patterns in other embryogenic and non-embryogenic genotypes are presently under study.

MOTHER CELLS FOR NODES AND INTERNODES ORIGINATE DIRECTLY UNDER THE TUNICA IN SOME PLANTS

Alicja M. Zobel, Department of Chemistry, Trent University, Peterborough, Ontario K9J 7B8

In the promeristem of some plant apices there are two layers of cells giving rise to the plant shoot. The first one is the tunica, from which originates tissue covering the whole plant body. Periclinal divisions in this layer below it produce, successively, node and internode mother cell layers. Differences in the number of cell divisions in these two mother layers lead to the formation of long internodes and short nodes. Phenolic compounds localized histochemically in the idioblastic cells, characteristic exclusively either of the node or of the internode, were the markers permitting localization of the mother cell layer either for the node or internode. Over a hundred species were examined for the occurrence of such periclinal divisions, here called differentiation divisions, in the second layer, which do not need to be frequent (10-40 times/year, thus once a week or even once a month), making them difficult to observe.

SHOULD THE GENUS *SAMBUCUS* BE REMOVED FROM CAPRIFOLIACEAE?

Alicja M. Zobel, Chemistry Dept., Trent University, Peterborough, Ontario K9J 7B8

Eight species of *Sambucus* were examined for morphological features characteristic exclusively for this genus, distinguishing it from the other genera of Caprifoliaceae. All eight species of *Sambucus* contained long (up to 32 cm) idioblastic coenocytic cells filled with phenolic compounds (Zobel 1975, 1979, 1986), which arise from their mother cells located in the first internode and grow simultaneously with all the neighbour cells. Coenocytes are located exclusively in the internodes of all *Sambucus* species examined, but do not occur in any other genus of Caprifoliaceae.

From the chemotaxonomical point of view *Sambucus* differs as well, because I have not found any coumarins in any of the species examined, but they are present in other genera. In view of the additional information (Chalk and Metcalf, 1980) that their leaf gap pattern is different, the possibility could be considered of removing it from the Caprifoliaceae.